rWeather

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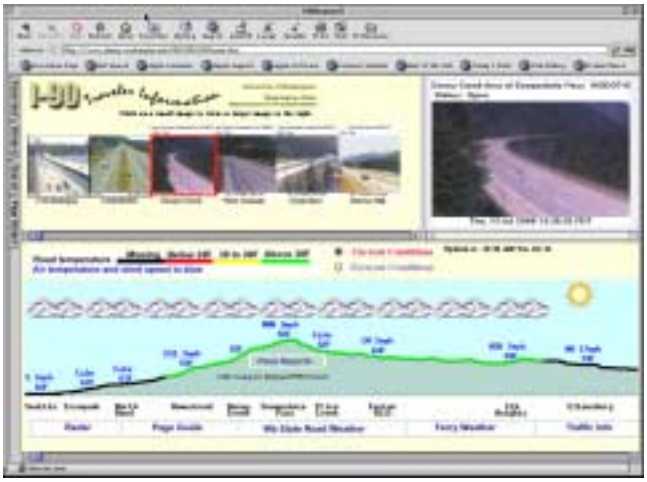
Road Temperatures And Weather Conditions Combined On The Internet - Just In Time For Winter

With winter approaching, conditions in Washington state's mountain passes are becoming more unpredictable and difficult. Just in time, rWeather is offering motorists a better way to plan their trips. The rWeather Web site now offers pages that combine road temperature and weather information for the I-90 and US Highway 2 mountain passes. Also recently added to the Web site is a statewide map of road surface temperatures.

rWeather is the Washington State Department of Transportation's (WSDOT) effort to collect real-time and predictive statewide road and weather information and disseminate it to WSDOT maintenance and other decision makers, as well as to the public. The rWeather Web site combines data from several sources and agencies and offers the data at a single location in a graphic format.

With the click of a mouse, any computer user with an Internet connection can access a central database of statewide traveler information. Starting at the home page, www.wsdot.wa.gov/rweather, **visitors can point to areas of the state and click to view specific highway and weather information.**



Route-Specific Road and Weather Information

Recently added to the Web site are pages that combine detailed road temperature and weather information for I-90, from Seattle to Ellensburg, and for US Highway 2, from Everett to Wenatchee. A cut-away view of each route allows users to see not only weather conditions, indicated with text and graphics, but also pavement conditions, indicated with a color-coded road. Visitors

can look at both current conditions and a 24-hour forecast. This combined information will be particularly helpful to indicate real-time or probable conditions of snow and ice. Both pages also include real-time camera images of the roadway, and on the I-90 page motorists can check out posted driving restrictions.

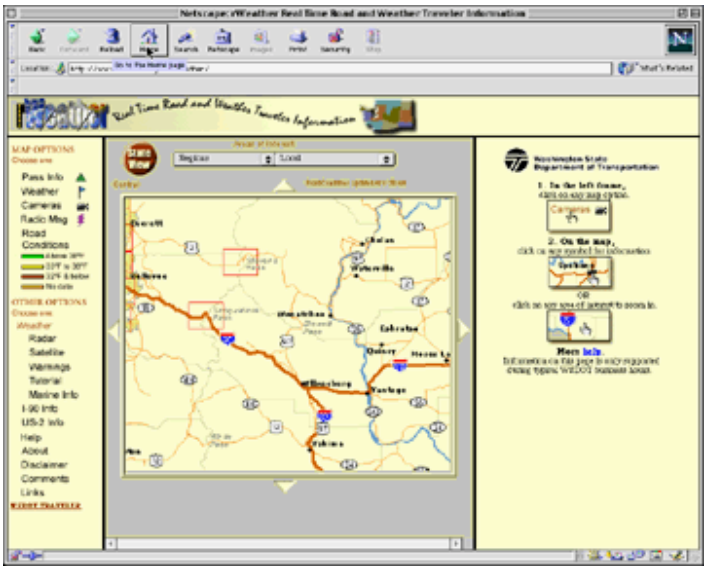
The data for these pages are collected from cameras, satellite and radar, WSDOT pass information, National Weather Service (NWS) zone forecasts, and atmospheric measurements (wind speed, direction, and air temperature). This is the only Web site where these data are combined to provide such comprehensive information.

Statewide Road Surface Temperatures

Also newly available is a statewide map of road surface temperatures. These predicted temperatures are modeled from detailed atmospheric data, and they cover all of Washington's interstates and many other state highways. By clicking on "Road Conditions" at the site's Home page, users can view a state map that combines data from three sources in one image. Road-specific data, as opposed to weather data that may or may not be measured near a roadway, are pulled from WSDOT's 30+ road-weather information stations, mountain pass reports, and other road surface temperature measurements. The map's color-coded roads indicate predicted road temperatures of above 38 degrees, 32 to 38 degrees, and below 32 degrees.

Improvements in Efficiency and Safety

This detailed information is helping the state better manage and maintain the roadways. For example, to make operational decisions about crew, equipment, and where to apply anti-icing compounds, operations personnel need to know whether a section of roadway will experience frost or ice. Timing is critical because applying the compound too early or too late is ineffective. In addition, being able to target problem areas is important because it is too costly to apply anti-icer to all roads in an area.



Obviously, such information is also helpful to the traveling public in planning safer trips, especially if they can accurately predict whether they will be likely to encounter snow or icy roads along the mountain passes.

One-Stop Access to It All

For nearly a year, the Web site has provided one-stop access to a wide variety of road and weather information:

- data from over 400 weather stations belonging to agencies associated with the Northwest Weather Consortium and from over 100 WSDOT traffic cameras
- WSDOT highway advisory radio (HAR) broadcasts from four stations on Snoqualmie Pass (I-90)
- pass reports for Washington's ten mountain pass highways
- FerryWeather, a report on marine conditions, forecasts, and warnings provided by Washington State Ferries and the NWS
- weather warnings, satellite images, and radar images.

The site is based on a clickable state map that allows users to find the information at the level of detail they need in the locations they require, with statewide, regional, and local views. Developers have been working hard to organize and offer the large amounts of information in ways that people find easy to manage. For example, whereas travelers might be most interested in knowing simply whether they'll encounter heavy rain along a freeway corridor, WSDOT maintenance engineers might want to know details about temperature, precipitation, and wind speed at specific sites along mountain pass roads. By providing increasingly specialized layers of information, the Web site is able to accommodate both needs.

Partnership and Collaboration

Partners in the rWeather program include WSDOT, the University of Washington (UW), the National Weather Service, and the Northwest Weather Consortium. Development of the rWeather Web site has been a collaboration between WSDOT and the UW.

The new route-specific pages are the product of UW researchers. In addition to collecting data from a variety of weather observation networks to produce rWeather's massive operational database, the UW purchased a powerful computer that is now used to forecast the weather over the entire state at the highest resolution in the nation. Researchers also developed a road condition prediction model for use with observed and forecast atmospheric data. That model provides the detailed forecasts of surface conditions now available for I-90 and US 2, as well as for the statewide map.

Why Do Snowplows Need Advanced Technology?

Besides making snowplow operation less stressful for drivers, there are a number of important reasons to integrate advanced technologies into snowplows.

In most locations where plows are used, roads must be kept open for reasons of both safety and economic necessity.

Improving plow productivity with advanced technologies will increase efficiency, allowing operators to open roads more quickly and keep them open more easily.

Collision avoidance is another important consideration. Snow covered cars or natural objects can be difficult to see. Roadside safety devices such as guard-rails, crash attenuators, and light poles are not only expensive to replace if hit, but severe injury could occur if a traveler were to crash into a damaged guardrail or crash cushion. Obviously, plows can also be damaged, and at $100,000 to $300,000 a vehicle, they are extremely expensive to repair.

Most important is improved safety for both plow drivers and the traveling public. Unfortunately, they cannot always see each other in stormy weather or in the snow cloud created by the plow itself. Advanced technologies can help plow drivers stay in the lane and detect objects in their path, and they can also help motorists avoid the plows.

rWeather into the Future

Funding for development of the system came from a combination of 80 percent federal and 20 percent state funds. WSDOT took the lead in soliciting and obtaining the federal grants and is exploring options to cover continuing operational costs, including federal grants, state funds, and private sponsorships. The site is fully funded through June 2001.

WSDOT and its partners will continue working to expand rWeather. For WSDOT personnel, rWeather means access to information about current and forecast road/weather system conditions that may affect operational decisions. Such information is predicted to save costs by reducing worker hours and use of resources. The greater amount of information also will aid marine and aviation interests. For the public, the result should be increased safety, because the site should allow travelers to make better pre-trip and en route decisions based on more up-to-date and accurate information.

rWeather visitors are encouraged to use the "Comments" section of the Web site to e-mail suggestions and questions about the project. For more information about rWeather or WSDOT's road/weather information system, contact Bill Brown at (206) 616-9183, <wwbrown@u.washington.edu>.

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Plowing Snow Will Be Safer And Easier with Integrated Technologies

Three Projects demonstrate the possibilities

Driving a snowplow in adverse and extreme conditions is not easy. Operators have to monitor their plow activity while also monitoring the application of salt, sand, or deicer. They have to communicate their activities to the dispatcher at regular intervals. Through the blowing snow and poor visibility, on icy, tractionless roads, they have to clear the roads while avoiding collisions that could damage their large snowplows or another car or roadside obstacle. On the line are great expense and the safety of themselves and the public.

To make snowplow operation easier, more efficient, and safer, several states around the country are investigating the application of advanced technologies to snowplow operations. For example, the Advanced Highway Maintenance and Construction Technology Center (AHMCT) at the University of California, Davis, is developing systems that can locate the roadway and obstacles under the snow. Current projects are RoadView and the Advanced Rotary Plow. In the Midwest, the Minnesota Department of Transportation is developing the Intelligent Vehicle Initiative Snowplow, which will include lateral guidance and collision avoidance systems, as well as a windshield heads-up display.

RoadView

The RoadView program is an extension of California's Advanced Snowplow Project, which successfully demonstrated a snowplow driver information system during the winters of 1998/1999 and 1999/2000. The RoadView program is seeking to move the advanced snowplow technology beyond field testing, into a commercial product.

Location Detection and Prediction, Collision Warning

Originally tested on a 10-wheel, 10-yard plow are a sensing system that detects current vehicle location, a prediction system that predicts future vehicle location, a collision warning system that detects obstacles and potential hazards, and an in-vehicle display that integrates all the information. All systems have been designed to operate in the harsh conditions typical of the snowplow environment.

For roadway guidance, specially designed magnets are installed in the pavement. The system uses magnetometers and vehicle posi-

tioning technologies for vehicle guidance. For obstacle detection, radar finds obstacles in the path of the snowplow. These radar units were designed to provide both the sensitivity necessary for accurate obstacle detection and the ruggedness necessary for durable reliability.

Ongoing Testing

The RoadView program has instrumented one plow for testing this winter both near the Donner summit on Interstate 80 (Calif.) and for one month on US 180 north of Flagstaff, Ariz. This plow was also tested at these two sites during the two previous winters.

The program is also instrumenting a second plow, expected to be in the field by mid-January 2001, for testing near Kingvale, Calif. In spring 2001, CalTrans will be adding magnets to a new test site on State Route 299 near Burney, Calif. The second vehicle will be tested at the Burney site during the winter of 2001/2002 and beyond. A third snowplow, to be completed some time during the winter of 2001/2002, will also be tested at the Burney site.

The AHMCT Center is also working on a related project to automate the surveying and installation tasks required to embed magnetic markers into the pavement. It hopes that the results of this project, which runs through March 2001, will enhance the commercial potential of the RoadView system.

The RoadView test is a pooled fund study sponsored by the California and Arizona departments of transportation. These states are seeking additional partners in the commercialization of the product.

Advanced Rotary Plow

Rotary snowplows, or snow blowers, are extremely important to snow removal operations in mountainous areas. To effectively remove built-up snow, drivers must plow at the edge of the road, with very tight tolerances. To do this, blower drivers tend to steer their large vehicles via tactile feedback, meaning that they use the guardrails to guide the blower along the unseen edge of the roadway. This quickly damages the guardrails, which are costly to repair. In addition, "driving by feel" can cause serious damage to the snow blower.

Another problem is collisions with vehicles or natural objects such as boulders and debris that are hidden by snow. Because of the large mass of the blower and the action of the rotary mechanism, the potential for damage to the foreign object or to the expensive

rotor is very high, even at the plow's low operating speed of 3 to 5 MPH.

Automated Driving Functions

On the basis of the success of the Advanced Snowplow Project, the AHMCT Center, in partnership with UC Berkeley's Partners for Advanced Transit and Highways Center (PATH) and the University of California at Berkeley, is developing automation for the driving functions of a rotary snow blower, including fully automated steering and possibly automated throttle and brake. The ability to exercise precise lateral control would reduce or eliminate contact between the blower and the guardrail, while also improving the repeatability and accuracy of the operation. In addition to automation of the driving function, researchers are investigating obstacle detection and collision warning for snow blowers.

Ongoing Testing

Because the Advanced Rotary Plow is a research prototype vehicle, only one is being built at this time. It will be tested this winter, but not fully automated. Instead, the vehicle will be operated manually while data are gathered from various sensors (magnetometers, steering sensor, and others). These data will be used to verify vehicle dynamic models and to develop specifications and the design of the steering actuators and controllers. The AHMCT expects to test full automation in the winters of 2001/2002 and 2002/2003 on US 50 at Echo Summit, Calif. The project runs through June of 2003.

Intelligent Vehicle Initiative Snowplow

The Intelligent Vehicle Initiative Field Operational Test is a three-year Minnesota effort to integrate and test various technologies and driver displays for safer driving in extreme low visibility conditions such as blowing snow, rain, and fog. The system is intended for installation on snowplows, as well as ambulances and state patrol cars.

Lane Guidance, Collision Warning, Heads-Up Display

For lane guidance, the Magnetic Lane Awareness System, developed by 3M, uses magnetic pavement marking tape that can take the place of regular lane striping. A magnetic sensor on the vehicle detects the tape when it is within one meter and indicates to the driver the vehicle's position within the lane. The tape can be either grooved in the existing pavement and secured with an adhesive or underlaid during construction. The tape is highly reflective, benefiting all vehicles that use the roadway.

A collision warning system developed by Altra Technologies uses 360-degree radar around the vehicle to detect and inform the driver of approaching obstacles. Radar detectors are mounted on the front, sides, and rear of the vehicle. On snowplows, the rear radar activates high intensity strobe lights mounted in the rear to alert drivers

behind the snowplow that they are too close.

A driver interface developed by the University of Minnesota (UM) uses a windshield heads-up display, differential global positioning, and a digital mapping/geospatial database of the corridor to project an image of lane boundaries and fixed roadside features (guardrails, signposts, and other obstacles), allowing the driver to "see" the roadway. This display also incorporates the information from the magnetic tape guidance and collision warning systems. Graphic icons in the display depict the position of the vehicle in the lane and any approaching objects. Researchers at the Human Factors Research Laboratory at the UM are currently testing a prototype of the heads-up display in the field to determine the best way to communicate warnings and other information.

2001 Prototype

The program is currently in a stage of refinement and integration. Researchers are talking to operations and maintenance people to verify their needs, refining designs, and developing specifications. The first integrated prototype will be built next spring. Drivers will be familiarized with the equipment next summer, and plans are for the operational test to take place in the fall and winter of 2001/2002.

The vehicles will be tested on 50 miles of Trunk Highway 7, from Hitchinson, Minnesota, to Minnetonka in Minneapolis/St. Paul, as well as on some adjacent county roads. These roads experience relatively heavy truck and commuter traffic, along with blowing and drifting snow. Three Minnesota DOT snowplows and one McLeod County snowplow, as well as a state patrol squad car and an ambulance, will be instrumented.

Further Information

For more information on the California projects, contact Ty Lasky, Research Engineer, AHMCT Research Center, at 530-752-6366 (talasky@ucdavis.edu) or visit

<http://www.ahmct.ucdavis.edu/roadview/index.html>

For further information about the Minnesota program, contact Bill Gardner, IVI Program Manager, at 651-282-2115 (william.gardner@dot.state.mn.us) or visit <http://www.dot.state.mn.us/guidestar/snowplow.html>

To discuss any of the information in this newsletter contact Bill Brown by email: <wwbrown@u.washington.edu> or by phone: (206)616-9183.

This newsletter was produced by Washington State Transportation Center in conjunction with WSDOT and FHWA and can be found at: <http://www.wsdot.wa.gov/eesc/ATB/rwisnews/frames.html>